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ABSTRACT

This report is the last in a four-part series of Strategies for Change. It offers examples for comparing the effectiveness of different instructional systems and of instructional evaluation in general. The first evaluation, on remedial English procedures, compares the effectiveness of instruction in English 1A freshman composition in terms of attrition rates. In the next, two comparisons of computer-assisted learning serve as examples of evaluating different instructional systems in terms of meeting objectives as measured by an examination. Finally, a number of informal evaluative efforts are reported that deal primarily with the solicitation of student opinion on the effectiveness of a learning situation. (Author/CA)

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STRATEGIES FOR CHANGE

PART IV

JC 710 147

COMPARING INSTRUCTIONAL EFFECTIVENESS

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Office of Educational Development
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UNIVERSITY OF CALIF.
LOS ANGELES

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CLEARINGHOUSE FOR
JUNIOR COLLEGE
INFORMATION

Part I of Strategies for Change examines current educational literature and finds that community colleges, as with all educational institutions, have made few efforts at developing aggressive administrative programs to foster innovation and equally few efforts to compare instructional systems with respect to effectiveness and costs. Part II presents a case history of the Coast Community College District's efforts of operating five such administrative programs. Part III describes some initial efforts at comparing the costs of different instructional systems. This part offers some examples of comparing the effectiveness of different instructional systems and of instructional evaluation in general.

Despite widespread literature regarding innovation and specific innovation projects, as found in such magazines as Telecommunications, Media, and Instructional Technology, relatively little is reported with respect to evaluating the relative effectiveness of any one particular innovative teaching technique as compared to any other. Moreover, what evidence is available suggests that it really doesn't make any difference. There is good reason to think however, that this evidence can be discounted inasmuch as it depends heavily upon normative evaluative data as opposed to the summative type of evaluation that measures the program against its specified educational objectives.

If comparing relative costs of different instructional programs and systems is difficult, comparing the <u>effectiveness</u> of these systems is even more so. These pages present examples of evaluative efforts exercised by the Coast Community College District in the past several months. The first of these deals with remedial English procedures and compares the effectiveness of instruction in English 1A Freshman Composition in terms of grades earned by students and in terms of attrition rates. This is an example of normative evaluation based upon grades assigned students by instructors.

The next two comparisons serve as examples of summative evaluation of different instructional systems in terms of meeting objectives as measured by an examination. This kind of comparison avoids problems of subjective evaluation characterizing normative comparisons and replaces them with equally difficult problems of test validity.

Finally, a number of informal evaluation efforts are reported. These deal primarily with solicitations of student opinion with respect to the effectiveness of a learning system. If community colleges serve the primary

purpose of meeting student needs, this type of evaluative technique is the only one that really makes sense, assuming that students have accurate perceptions of their educational needs.

REMEDIAL ENGLISH PROCEDURES: BEFORE AND AFTER

Starting with the Fall semester 1968-69, remedial English at Orange Coast College was taught to students requiring it as an integral part of their experience in English 1A, Freshman Composition. This procedure represented a change over previous years during which students needing remedial work in grammar, syntax and other matters first completed a remedial English course before enrolling in English 1A.

The Office of Educational Development of the Coast Community College District gathered data for the purpose of determining, if possible, the extent to which student performance in English 1A as measured by grades and attrition rates changed substantially after the inauguration of the new policy regarding remedial work in English. Exhibit IVA shows grade assignments for all students enrolled in English 1A during this four-year period. The column headed "Before" shows grades earned by students during the four semesters spanning the Fall of 1966 and the Spring of 1968. The "After" column shows grades earned by students during the four semesters starting with the Fall of 1968 and ending with the Spring of 1970. The terms "Before" and "After" at the head of these columns indicate that the right-most grade distribution reflects grades earned after the new procedures were inaugurated. The other column indicates grades earned before their inauguration.

Grade point averages for the English 1A course increased slightly as between the "Before" and "After" groups. Statistical number-pushing showed

GRADE DISTRIBUTION FOR ENGLISH 1A

	Before	After
Grade Point Average	2.49	2.67
Percentage Completing Course	63.2	65.1
Percentage Completing Course Successfully	57.4	62.5
Number receiving A	397	627
Number receiving B	1,022	1,493
Number receiving C	1,022	1,128
Number receiving D	200	126
Number receiving F	46	7
Number receiving Cr	0	0
Number receiving NCr	0	19
Number receiving I	48	123
Number receiving W	1,481	1,664
Number receiving WF	33	6
Total Enrollment	4,249	5,193

EXHIBIT IV A

that this increase is significant at the .01 level of confidence (Ferguson, pages 155, 167-168). This means that the difference in grade point averages between the "Before" group of students and the "After" group of students probably did not come about by sheer chance. The percentage of students completing the course with a grade of A, B, C, D, F, or Credit increased from 63.2 for students taking English 1A during the years 1966 through 1968 to 65.1 for those enrolling in English 1A from 1968 through 1970. Application of statistical procedures shows that this increase probably did not come about by chance either, that is to say, that the increase is significant statistically at the .01 level of confidence.

The percentage of students completing the course successfully, that is, completing it with either an A, B, or C grade rose from 57.4 percent for the "Before" group to 62.5 percent for the "After" group. This increase of 5.1 percentage points is also statistically significant at the .01 level of confidence.

This is not to say, however, that the increase of grade point average or of percentage of students completing the course is necessarily an important increase or that it necessarily vindicates the changes in procedure. It does say that for some reason a few more students completed the course in the "After" group than completed the same course in the "Before" group and that students completing the course earned slightly higher grades. Whether or not this reason is directly related to the changes in remedial instruction procedures cannot be determined from these numbers.

COMPUTER ASSISTED LEARNING TO TEACH COMPUTER OPERATIONS

During the Spring semester, 1969-70, two Orange Coast College instructors designed and implemented a number of computer assisted instruction (CAI) segments for use in the computer operations course offered at their college. This work was done under the auspices of a Faculty Fellowship. Among other things, the segments included routines specifically devoted to the teaching of IBM System/360 Disk Operating System computer operator commands.

The procedures followed in this project consisted of six steps. Each of these is briefly described in the paragraphs that follow.

Design CAI Segments

The objectives of the operator command portion of the computer operations course included the following:

a. Students should be able to recognize correct Disk Operator Systems (DOS) operator commands in relation to specified computer functions to be performed. Achievement of this objective is measured by multiple choice examination questions.

b. Students should be able to identify computer system functions that take place as a result of executing specified operator commands as measured by multiple choice examination questions.

c. Students should be able to distinguish between correct and incorrect operator commands and operator procedures as measured by true-false examination questions.

d. Students should be able to provide the correct computer operator commands needed to cause specified computer functions to be performed as measured by fill-in examination questions.

e. Students should be able to describe specific steps to be taken by a computer operator to cause the computer system to perform specified computer functions as measured by essay examination questions.

f. Students should be able to define certain terms used in computer operations as measured by essay examination questions.

g. Students should be able to describe and provide examples of the operation of specific operator commands as measured by essay examination questions.

Computer assisted learning segments simulating the disk operating system of the IBM System/360 Model 50 Computer and offering tutorial material teaching operator commands were designed to offer students the opportunity to control a complex computer software system without requiring the dedicated use of the computer system. Altogether, these computer assisted learning segments replace approximately five hours of lecture materials dealing with DOS operator commands.

Test the CAI Segments

The computer assisted instruction segments were tested in two ways. First, they were used by students in the computer operations course offered during the Spring semester, 1969-70. Second, they were examined and used by ten data processing instructors attending the Summer Institute in Data Processing conducted by Orange Coast College during the months of July and August, 1970. This Institute was attended by experienced data processing instructors who came for the purpose of studying advanced topics in modern computer system programming and operation.

The students using the materials during the Spring semester found them to be a most enjoyable way to learn computer operations. It was thus established that students undergoing training in the subject matter, using computer assisted instruction materials, would not react unfavorably to the materials by virtue of their intrinsic nature. The data processing teachers similarly found the CAI segments most promising and became quite excited about their use.

This testing program and the resulting changes made to the CAI segments assured us that the learning materials that had been developed were acceptable on the part of both data processing teachers and data processing students and deserved further examination to determine their relative effectiveness in achieving specific objectives of the computer operations course.

Establish Control and Experimental Groups

The population of this study consists of 28 students who completed the computer operations course offered at Orange Coast College during the Fall semester, 1970-71. At the start of the course, these students were divided into a control group (15 members) and an experimental group (13 members). The control group received conventional classroom instruction in matters dealing with computer operation. This instruction consisted of classroom lectures and demonstrations. The experimental group studied computer operation through the use of computer assisted instruction segments.

The students were divided into control and experimental groups on the basis of two factors. First, each student was asked to fill out a short questionnaire designed to determine the degree of experience he might have in data processing prior to enrolling in the course. The questionnaire also determined what other data processing courses the student had completed. Each member of the computer operations class also took the SCAT II examination.

The members of the class were then divided into two groups, A Group and B Group, based upon previous training and experience as determined from the class questionnaire. The mean SCAT II scores of these two groups were then compared to determine whether or not there was a statistically significant difference in measured ability between the groups. Exhibit IV B shows the composition of the two groups and the SCAT II scores for each member of the

SCAT II SCORES

GROUP A		GROUP B	
Student	Scat	Student	Scat
1	88	16	80
2	79	17	78
3	70	18	71
4	69	19	61
5	63	20	61
6	61	21	58
7	60	22	53
8	58	23	53
9	55	24	49
10	53	25	48
11	51	26	47
12	48	27	36
13	47	28	29
14	43		
15	17		

EXHIBIT IV B

class. Homoscedasticity for the two groups with respect to SCAT II scores was verified by finding the ratio between their variances and using it to consult a table of the F distribution. No statistically significant (.05 level of confidence) difference between the variances was found. The W. S. Gosset formula was used to calculate t (Ferguson, pages 155, 167-168). This yielded a t score of 0.29 which was not significant at the .05 level. This indicated that there was no significant difference between the two groups with respect to SCAT II scores. Thus, the control group and the experimental group were judged to be about equal, both in terms of ability as measured by the SCAT II score and in terms of previous training and experience as determined through the use of the class questionnaire.

Conduct Training

Instruction was given to the control group following conventional classroom procedures including lecture and classroom discussion and demonstrations. The experimental group did not receive lecture or classroom discussion in the area of computer operations but limited their training experiences in this area to the computer assisted instruction segments. The control group participated in two classroom sessions of three hours each during which the conventional instruction was offered. The experimental group spent at least this much time proceeding through the CAI segments and were told that they could spend as much time as they liked using these materials. Both the experimental and the control group members could approach the instructor and ask questions on an individual basis.

In addition to classroom instruction and computer assisted instruction, students participated in the execution of laboratory exercises in which they actually operated the computer system. Each student did this as a member of a

team. The class was divided into four teams, two teams from the experimental group and two teams from the control group. Each team was given a number of laboratory exercises and made use of the computer facilities to execute the exercise. Each laboratory exercise required 45 minutes for execution.

Administer Examination

After the training was completed, all students in the class took an examination testing for the achievement of the objectives of this portion of the course. The examination consisted of 43 multiple choice questions, 20 true-false questions, 10 fill-in questions, four essay questions, and required students to describe the specific computer operations of 13 operator commands commonly used by computer operators.

Compare the Examination Scores of the Control and Experimental Groups

Exhibit IV C shows the examination scores for students in both Group A and Group B. Examination scores were tested for homogeniety of variance as described earlier with respect to SCAT II scores. This examination showed that there is no statistically significant difference (.05 level of confidence) between the variances in examination scores for the two groups. Application of the Gosset t test yielded a t score of 0.12. This score reveals no significant difference between mean examination scores of students in Groups A and B at the .05 level of confidence.

Results

Objective analysis following the procedures described above show no significant difference in performance between that group of students who studied operator commands through the use of CAI segments as compared with those who studied it using only conventional classroom instruction techniques.

EXAMINATION SCORES

GROUP A		GROUP B	
Student	Exam	Student	Exam
1	276	16	256
2	254	17	276
3	232	18	254
4	250	19	257
5	266	20	285
6	266	21	261
7	254	22	236
8	268	23	262
9	256	24	253
10	278	25	258
11	198	26	268
12	250	27	254
13	272	28	120
14	240		
15	154		

EXAM SCORE STATISTICS	
SAMPLE	15
MAXIMUM	278
MINIMUM	154
RANGE	124
MEAN	247.6
VARIANCE	1078.97
STANDARD DEVIATION	32.85

EXAM SCORE STATISTICS	
SAMPLE	13
MAXIMUM	285
MINIMUM	120
RANGE	165
MEAN	249.23
VARIANCE	1647.36
STANDARD DEVIATION	40.59

EXHIBIT IV C

Subjectively, however, two observations were made by the instructor. First, that portion of the computer assisted learning materials in which the operation of a computer console was simulated by an APL terminal was not as enthusiastically received by the students as was the tutorial computer assisted learning materials presented through the APL terminals. The instructor explained this phenomenon by reasoning that an APL terminal simulating a console typewriter terminal offers nothing more in terms of learning experiences than does the console typewriter itself. Students may as well go directly to the computer console and try to learn to operate it by relying entirely upon operator's manuals and other manufacuter's applications. The tutorial materials, on the other hand, offered learning experiences that analyzed students' errors and guided them through various learning processes. This was received much more warmly on the part of students than were the simulation exercises and the instructor believes that, for this subject matter at least, the tutorial method of computer assisted learning is by far the best.

The instructor also observed that the experimental group seemed considerably more confident and were better organized in the laboratory exercises than were members of the control group. Teams 1 and 2, the teams from the control group, had considerable difficulty executing the laboratory exercises with the computer system. One of them did not complete them within the allowed time at all. Teams 3 and 4, however, both drawn from the experimental group, completed the exercises within the allotted 45 minutes and Team 3 completed it in only 15 minutes. Although not all of this difference in performance can be directly attributed to the computer assisted instruction exercises, one would like to think that improved performance at the computer itself is more important than the lack of score differences on a written examination.

The laboratory performance difference is not merely a result of the experimental group working with computer machinery and the control group not. In point of fact, both the experimental and the control group worked extensively with the computer throughout the course. The only additional computer exposure enjoyed by the experimental group over the control group had to do with the completion of the computer assisted learning segments themselves. This additional exposure cannot alone result in the different performance levels observed in the computer room.

Conclusions

This small study reenforced in many ways what educators have learned about other similar studies regarding the relative effectiveness of different instructional techniques (Dubin and Taveggia). By and large, such studies all demonstrate that, at least judged by teacher evaluation in the form of course grades and examination scores, any one instructional technique is neither better nor worse than any other. This too, apparently, is true for computer assisted instruction with respect to teaching computer operator commands. In short, the objective results of this study, namely that there is not significant difference in test scores between the control and experimental groups, does not tell us anything we did not expect to find out. However, the subjective results that students seem more enthusiastic and seem to perform better in the real world environment of the computer room, seemed more encouraging.

Of course, one may argue that the increased enthusiasm on the part of students as well as on the part of the data processing instructors exposed to the CAI segments is merely the result of novelty. This may be so. However, it renders the differences in computer room performance nonetheless important.

If the use of novel instructional techniques will do a better job of teaching, then surely we must use them. It remains to be seen whether or not the novel aspects, if that is what they are, of computer assisted instruction will soon wear off. If they do, then we must look beyond novelty and try to judge the merit of this new instructional technique on its intrinsic worth.

COMPUTER ASSISTED INSTRUCTION FOR LAW ENFORCEMENT

The analysis described here was performed as part of Project CALCOP, an experimental project conducted jointly by Golden West College and the Los Angeles Police Academy. It was financed under a grant from the Law Enforcement Assistance Administration under the Omnibus Crime Bill.

Project CALCOP served a two-fold purpose. First, the project sought to develop a computer assisted learning system for the purpose of training in the area of search and seizure. Second, the project evaluated the effectiveness of the computer assisted learning system. In doing this, the project examined the hypothesis that the learning system designed by the project, consisting in independent study and CAI exercises, would be more effective than conventional classroom instruction.

Procedures followed in Project CALCOP are enumerated below:

1. Objectives of training programs in search and seizure and rules of evidence were formulated.

2. An examination designed to test the degree to which the objectives were met was developed and validated.

3. A syllabus of cognant material to be used for study purposes on an independent basis was prepared.

4. Case problems simulated through the use of the computer terminal were prepared and implemented.

5. Training was conducted using the computer assisted learning system and the syllabus at Golden West College. Training also took place through conventional classroom instruction at the Los Angeles Police Academy.

6. The examination was administered to police cadets at both the Los Angeles Police Academy and the Golden West Academy. Performance on this examination was compared between the two groups to determine if the computer assisted instruction techniques were more or less effective than conventional classroom techniques.

Evaluation of the learning procedures designed as part of Project CALCOP followed conventional statistical procedure. The project was interested in the null hypothesis that there would be no significant difference in performance levels between cadets at the Golden West Police Academy (the experimental group) and cadets at the Los Angeles Police Academy (the control group) as measured by a common examination. Finding a statistically significant difference would give cause to reject the null hypothesis, concluding that the CAI learning procedures were either more or less effective than the conventional procedures, depending upon the sign of the difference.

Comparison of performance scores between the control and experimental groups with respect to the CALCOP examination enactments as well as on the California Short Form Test of Mental Maturity and the Wonderlic Personnel Test made use of the t test for significant differences in mean scores and the Wilcoxon matched pairs signed-rank test (Ferguson, pages 167-174).

Examination Preparation

Inasmuch as the purpose of the evaluative phase of Project CALCOP was to measure the relative effectiveness of the computer assisted instruction techniques with conventional classroom presentation techniques, a first important task of the project was to develop the final examination. An initial examination was developed by instructors of the Golden West College Law Enforcement Program. The examination was tested at the Los Angeles Police Academy. Groups of cadets at the Academy would take the examination. After scoring,

the cadets and the instructor would critique the examination in terms of clarity and legal accuracy. After making appropriate modifications, the instructor would administer the examination to a fresh group of cadets and repeat the evaluation. In this manner, cadet reactions to and performance on the examination was carefully considered in subsequent revisions of the final examination. Revisions were retested as described above until the final draft of the examination was completed.

Control and Experimental Group Selection

The experimental group for this study consisted initially of twenty-seven police cadets enrolled in the Golden West College Police Academy during the Fall semester, 1970-71. This group undertook to study matters of search and seizure through independent use of the syllabus and through the use of the computer assisted instruction simulation exercises described earlier in this report.

The control group for the experiment consisted of police cadets at the Los Angeles Police Academy who undertook to study matters of search and seizure through conventional classroom instruction as conducted at that Academy. Sixty police cadets out of a class of seventy-one at the Los Angeles Academy took the final examination enactments.

Members of both the control and the experimental groups took the California Short Form Test of Mental Maturity and the Wonderlic Personnel Test. Using the IQ scores achieved on the California Short Form Test of Mental Maturity as a basis, twenty-seven members of the Los Angeles Police Academy group were selected so as to give twenty-seven matching pairs of cadets, one group each from the Golden West College Police Academy and from the Los Angeles Police Academy.

The District employed a number of tests and comparisons making use of Wonderlic and IQ scores. As a result of these calculations and comparisons, it made the following observations:

1. There is no significant difference in mean IQ scores as measured by the California Short Form Test of Mental Maturity between the twenty-three member experimental group at Golden West College and the twenty-three member control group at the Los Angeles Police Academy.

2. There is no significant difference in mean Wonderlic Personnel Test scores between the control group and the experimental group.

3. The control group of Los Angeles Police Academy cadets is a representative sample in terms of IQ and Wonderlic scores of the total seventy-one member group of Los Angeles Police Academy cadets.

4. There is no significant difference in either mean IQ scores or in mean Wonderlic scores between the Golden West College experimental group and the total group of Los Angeles Police Academy cadets.

Accordingly, any differences to be found between performance levels on the examination enactments as between Group 1 and Group 2 could not be attributed to differences in ability as measured by the California Short Form Test of Mental Maturity and the Wonderlic Personnel Test. Differences in performance levels on the final examination must be accounted for by other factors.

Training

Police cadets at the Los Angeles Police Academy studied materials relating to proper procedures in search and seizure matters under conventional classroom instruction. This instruction consisted of lectures and classroom discussions. Police cadets at the Golden West College Police Academy studied the same materials making use of the study syllabus and the computer assisted simulated case problems. This group received no classroom instruction.

Examining

After completing the training program in search and seizure, cadets at both the Police Academy in Los Angeles and the Academy at Golden West College completed a written examination consisting of case problems or enactments in which the student was asked specific questions about procedures and matters of fact relating to the situation described.

Results

Both the t test and the Wilcoxon matched pairs signed-rank tests were applied to the performance scores on the examination enactment. In every case, cadets at the Golden West Police Academy performed better on the final examination than did cadets at the Los Angeles Police Academy and in every case the difference in performance levels was statistically significant at the .05 level of confidence.

Conclusions

The most obvious conclusion to be drawn from the procedures outlined above says that the learning procedures followed at Golden West College in the area of search and seizure were more effective than were the procedures followed at the Los Angeles Police Academy, at lease as measured by the final examination. The District has this to say in their final report on Project CALCOP.

> We assert, and our conclusions here are based upon the statistics reported above, that this basic difference in instructional approach accounts for the differences we find in performance levels between the Los Angeles Police Academy conrol group and the Golden West College Academy experimental group (Project CALCOP Final Report, p. 23).

Following this assertion, the final report considers a number of other factors that might account for the performance differences between the control and experimental groups. These factors included experimental bias (the so-called Hawthorne effect), examination procedures and previous experience of police cadets (Project CALCOP Final Report, pp. 23-27). Dispatching these as matters not affecting cadet performance through the use of statistical analysis, the investigators summarized:

> Although we are not prepared on the basis of Project CALCOP to conclude that the computer assisted learning portion of the learning system devised is more effective than classroom instruction, we do think that the total learning system including independent study of the syllabus as well as computer assisted case problems, presents a more effective learning environment in the area of search and seizure than does conventional classroom instruction. This is not to say, of course, that conventional classroom instruction has been other than excellent in quality. In fact we cannot say, as a result of this study, that it has been good, bad, or indifferent. Rather, we have found evidence that instructional effectiveness in search and seizure can be further improved through the use of learning systems similar to that developed by project CALCOP (Project CALCOP Final Report, pp. 27-28).

INFORMAL EVALUATION

Most instructional evaluation at the Coast Community College District takes place on an informal basis and draws heavily on student reaction to the total instructional program. Student reaction is often solicited through the use of end-of-the course questionnaires administered to students by faculty members. Quite often, even more casual observation serves as the basis of evaluating the effectiveness of the particular type of instruction.

This portion of the paper presents some verbatim comments delivered to the Office of Educational Development by faculty members who were engaged in

evaluating instructional systems prepared under the auspices of the Faculty Fellowship Program. The first of these reports the degree to which students made some use of sound-on-slide materials developed as a supplementary learning system for large group instruction in Psychology 1A. The report identifies a couple of problems in conducting large group instruction and then presents the sound-on-slide system as an effort to solve some of these problems. The second report, and the more rigorous of the three, presents the findings of a fairly extensive survey of students making use of the Math-Tutorial Center at Golden West College. In addition to soliciting student views on it, some effort was expended toward a normative evaluation of actual student performance. The third report, making only casual reference to student performance, devotes itself mostly to evaluating the mechanical devices used in the project and to clapping the Office of Educational Development and other District workers on the back for their help in executing the project.

Sound-On-Slides

This project was to develop "100 sound-on-slide conceptual units to be used by the division in it's instructional activities." It was understood that this objective was so designed as to allow a high degree of flexibility as needs become evident during the development of the project.

Procedures - After purchasing the necessary supplies and equipment, discussing and demonstrating the hardware capabilities with members of the staff and beginning a unit on the history of Psychology; some considerations that were to guide the rest of the project emerged. In effect they were as follows:

1. Certain students in Introductory Psychology find the large-group situation both frustrating and difficult. Often the core of the

dissatisfaction stems from the perceived difficulty of the evaluation instruments used in the class. Though a great deal of effort had been made to standardize test feedback, this aspect of the instructional program left much to be desired.

2. Unfortunately, the large-group situation often seemed most disconcerting to the highly motivated student and to the student who was slightly below average in learning ability. It was felt that both these groups of students could profit from some form of individualized access to test feedback.

In a converstaion with Roy Andreen, (Dean, Counseling and Guidance) he suggested the possibility of using the sound-on-slide equipment for test feedback. This set the wheels in motion for what appears to be a very effective innovation in a Psychology program.

During the Spring semester of 1970, each question used in the large-group was typed on an 8 1/2" X 11" sheet of plain paper with the primary typewriter. A 35mm slide was made of them and they were placed in the sound-on-slide machine. The teacher who had submitted each question then prepared a 35 second audio explanation explaining the principle, concept of objective of the question, the correct answer, why that was the correct answer, and where the answer could be found (in the lecture or text page). After each 50-question examination these units were made available in the multi-media center in the library on a voluntary basis to students.

It is significant that the final examination in this course is comprehensive and consists of 100 questions. Fifty of these questions reflect the principles already tested for during the semester. The assumption is that a

motivated student can go over the 150 questions in the machine just prior to the final and have reviewed for him approximately one-half of the final.

We demonstrated this equipment to the students in the large-group immediately after the first examination and instructed them regarding its availability.

Findings - Wereceived considerable positive feedback from both students and seminar teachers. The most significant consideration seems to me to be the number of students who availed themselves of the equipment. According to the console operator, 371 requests were logged for the machine. In view of the fact that there were usually several students watching it at once--on occasion as many as ten--it becomes evident that the students did perceive it as an effective adjunct to their study.

Conclusions - We are involved right now in preparing the test questions for our first fifty question examination. It is a time consuming, at times, laborious task but it appears that the staff considers it worthwhile. I suspect that we have, with a very moderate investment, offset some of the disadvantages of the large-group class. Hopefully, that student who doesn't learn too rapidly, and the one who is willing to spend extra time to do better; now has at his disposal a structured review with some answers as well as some reasons why, pertinent to the objectives of the course.

Someday, when time permits, I would still like to put together a few units on some topics in Psychology. The slides on a unit in the History of Psychology are already finished. This, however, will have to wait because we do feel that existing use of our time, and that of the machine, is being used most effectively in the present application.

Math Tutorial Center

As the result of funding through a Faculty Fellowship, the Golden West Math Council was able to offer a mathematics tutorial service during the Spring semester of 1970. This service was available to students seeking individual assistance in mathematics.

The purpose of this paper is to describe the tutorial services provided, to report on the data collected regarding the services, and to offer an evaluation and recommendations which may be useful for the operation of future mathematics tutorial services.

Description of the Services -

Purpose: A Mathematics Tutorial Center was established at Golden West to provide individual assistance to students having difficulty in mathematics.

Facilities: A room in the College Center was reserved for the tutoring services. The room was equipped with tables, chairs and a portable blackboard.

Hours: The services began on February 11 and continued until the beginning of final examination (June 4) and was available on a daily basis between the hours of 8 a.m. and 2 p.m.

Staff: Members of the mathematics faculty and nine advanced math students served as tutors for the Center with from one to three tutors assigned each hour in the Center. The student tutors hired were recommended by the math faculty. Each math instructor donated two hours a week in the Center while the student tutors spent a total of 40 hours a week in the Center, making the total tutor time 52 hours.

The Math/Science Division Counselor acted as Director of the Tutorial Center and a student lab assistant was hired to assist with the clerical work.

Research and Data Collected - Throughout the semester several procedures were used to collect data and provide research relevant to the tutoring services:

a. "Log" sheets were maintained on a daily basis in the Center to record the student use of the services.
b. Questionnaires were distributed in all the math classes toward the end of the semester primarily for the purpose of evaluating the services.
c. Analysis of previous math grades and Spring semester grades was done in an attempt to determine if there was a difference in performance in math by those students who used the services as compared with students who did not use the services.

Following is a summary of what appears to this writer to be significant information provided by the data collected from the "log" sheets and questionnaires.

Who Used the Tutorial Services?

a. Of the 173 students who used the services, 86% were pre-calculus students.
b. Students from Math A, C, and D accounted for 60% of the total number of students who used the services.
c. At least 35% of the students who registered in a math class Spring semester used the tutorial services.

How Often Were the Tutorial Services Used?

a. According to the "log" sheets, at least 173 students used the Center a total of 876 times.
b. The Center was used by pre-calculus students 85% of the time, with students from Math A, C, and D using the services 60% of the time. (There is evidence that not all students signed the "log" sheet each time they used the Center. It is probable that the actual number of times they spent in the Center is greater than 876.)
c. The responses on the questionnaires indicate 44% of the students who used the services returned 5 or more times.

What Reasons Did the Students Give for Not Using the Center?

a. "I did not need any tutoring in math," was the reason given most often for not using the Center (1/3 of the responses).
b. Twenty percent said they did not use the Center because the times available for tutoring were not convenient for them, with an equal number of students selecting "other" as the reason for not using the Center.

What Reasons Did the Students Give for Not Returning to the Center?

a. The reason given 30% of the time was that they did not need any tutoring.

b. Seventeen students said they were not satisfied with the help the received when they did go.
c. Twelve students said the hours available were not convenient to them.

When Was the Tutorial Center Used Most Often?

a. The distribution of students using the Center per day was fairly even, with a slightly higher attendance on Wednesday and Thursdays, and the lowest percentage of attendance on Mondays.
b. The distribution of students using the Center per hour was heaviest during the morning hours, from 8 to 11 a.m., gradually tapering off from 11 to 2.

During What Hours Would the Students Prefer the Tutorial Center to be Available?

a. Eighty percent of the response indicated a preference for the Center to be open between 7 a.m. and 5 p.m. with 75 % favoring the hours between 9 a.m. and 3 p.m.
b. Fourty students expressed a desire for the Center to be open in the evenings.

How Did Students Rate the Help Given at the Center?

a. In rating the student tutors, 65% of the pre-calculus students said all or most of the student tutors were very helpful. 75% of the calculus students said all or most of the student tutors were very helpful.
b. In rating math instructors, 85% of pre-calculus students said most or all of the math instructors were very helpful. 84% of the calculus students also said most of the instructors were very helpful.

What Effect Did Students Feel the Tutorial Center Had on Their Attitudes, Understanding, and/or Grades in Math?

a. Over 50% of the students said their attitude about mathematics had improved since they had been at Golden West, 40% said their attitude had stayed the same, and 6% said their attitude about math had become worse.
b. The students attributed their change on attitude most often to their math instructors at Golden West (66% of the responses).
c. Sixty percent of the students who used the tutorial services attributed their change to their instructors, while 18% attributed the change to their use of the Tutorial Center.
d. 1/4 of the students felt their use of the Center had resulted in their getting better grades in math.
e. Sixty percent of the students who used the Tutorial Center felt their use of the services had increased their understanding of math.
f. Less than 2% said it confused them more than helped them.

g. Fourteen percent said their use of the Center made no difference in their performance in math.

How Necessary Did the Students Feel the Center Was and How Did They Feel It Compared To Other Sources of Help?

a. Seventy-five percent of the students felt they would have received the help they needed if there had been no Tutorial Center.
b. Of those students who said they would gotten (sic) the help they needed, 42% indicated they would have gotten it from their math instructor while 47% said they would have gotten help from another student or friend.
c. Twenty percent felt this help would have been better than the Center, 56% felt it would have been as adequate as the Center, and 24% felt the help would not have been as adequate as the Tutorial Center.

What Criticism Was Given Regarding the Center? - Following are comments given most often by students as paraphrased by this writer:

a. Students disliked having to wait for help during the busy hours.
b. They expressed a need for more tutors and quieter facilities.
c. Many felt the Center's hours were not convenient.
d. Higher math students expressed a need for more advanced tutors.

What Did the Students Like About the Center? - Following are comments given most often by students as paraphrased by this writer:

a. A number of students indicated the tutors were always willing to help and were very patient.
b. Some students said they liked the Center because they felt more comfortable getting help from students than instructors.
c. Many students felt it lessened anxiety as it was "always there when you needed help."
d. Students indicated they were able to get more individual attention than was possible in class.
e. A common comment was "it made the difference."

Probably the most important question to be answered with regards to the mathematics tutorial services is did it make a difference in how a student performed in mathematics? As a result of using the services, did he understand math better or get better grades or did it keep him from dropping his math class? According to the questionnaires, the students felt using the tutoring services made a difference or did these things.

An attempt was made to determine if there was, in fact, a difference in the performance in mathematics between those students who used the services and those who did not use the services. From hereon, those students who used the services will be known as Group 1 and students who did not use the services as Group 2. Group 1 was arbitrarily defined as any day school math student at Golden West who used the tutorial services 5 or more times while Group 2 was determined as any student enrolled in a day school math class (excluding Math 51, A(R), D(R), 7, 42, 44) at Golden West who used the services less than 5 times as recorded on the "log" sheets.

Several comparisons were made between Group 1 and 2 to determine if there was a significant difference in the performance of the two groups. Before the results of these comparisons are given, some of the limitations of the methods used in testing for a significant difference should be pointed out:

1. No attempt was made to match students who used the services with a control group; all students who wanted to use the tutorial services were allowed to do so. One may therefore conjecture that Group 1 is a biased sample simply because of their motivation to use the tutoring services as compared to Group 2 who chose not to use the services. It is probably true Group 1 is a different type of student in the first place and unrepresentative of the population, thus any difference in math performance cannot necessarily be attributed to the use of the math tutorial services.

2. The statistical techniques used for tests of significance had to assume the groups were randomized with regards to instructors, math courses and grading policies. The number of students involved was too small to keep these variables constant for the comparison of any particular group.

Following is a summary of the comparisons made between Groups 1 and 2 and the results of the comparisons.

1. Was there a significant difference between the groups in the performance in their previous math class? Were the students who used the tutoring services better or worse students in math to begin with than the students who did not use the services?

A comparison of the grade point averages of Group 1 and Group 2 in their last math class showed no significant difference between the groups in their previous grades in math classes.

2. Was there a significant difference in the grade point averages of the two groups as determined by their final grades in math Spring semester? Did the students who used the services do better or worse in math Spring semester than those who did not use the services?

   A comparison of the grade point averages of Group 1 and Group 2 in their final grades Spring semester in math showed no significant difference between the groups in their performance in mathematics.

3. Was there a significant difference between the groups when their Spring semester final grades were compared with their grades in their previous math class? That is, did students who used the services do better on the average, or worse in their present math class than they had done previously in math compared with those who did not use the services?

   The difference between the grade point average of the previous math course and the grade point average of the Spring semester math course was determined from Groups 1 and 2. A comparison of this grade point average difference showed no significant difference between the groups.

Evaluation and Recommendations - From the total number of student contact/hours in the Center and the effect the student said the tutorial services had on their attitudes, understanding and grades in math, one can conclude the Math Tutorial Center was very successful in fulfilling a valuable need for a substantial number of students. In summarizing the evaluations given by students and instructors regarding the Center, greatest benefits of the services seemed to be from the fact that students had the opportunity to receive one-to-one assistance from qualified individuals at the time they needed it.

With the exception of a need for more tutors at peak times during the semester, the facilities, staff and method of operation of the Tutorial Center appeared to be more than adequate for the successful functioning of the Center. The following changes are offered for improvement in the operation of future math tutorial services.

1. More tutor time be concentrated at the beginning of the semester, primarily in the morning hours.
2. A sufficient number of tutors be hired who are particularly qualified in tutoring the subjects of elementary algebra, intermediate algebra, and trigonometry.
3. Student tutors be oriented in how to tutor students. For example, not to spend too much time with one student while others are waiting; not to do all the student's homework; if can't answer question, refer student to an instructor.
4. Consideration be given to offering math tutorial services in the evening.
5. Post the times there will be tutors in the Center who are particularly qualified to assist higher math students.

Producing Media For Medical-Surgical Nursing

This project was prepared to utilize the audio-tutorial laboratory for individual study, to produce a syllabus for Nursing 30 (Medical-Surgical-I) and to prepare some slides-tape programs on selected subjects. Two of these objectives have been completed.

Preparation & Findings -

1. A 175 page syllabus for Medical-Surgical Nursing I was produced and will be ready for student purchase in the bookstore for Fall semester.
2. Approximately 200 slides were made on the subjects of water and electrolyte balance in relation to the patient with gastrointestinal, kidney, and lung problems. Audio-tapes, worksheets, and post-tests were also prepared for these exercises. The results of the post-test indicate that the majority of the students who did all the exercises in the audio-tutorial laboratory scored higher than students who did only the assigned work.

A questionnaire on various teaching method preferences was given to the freshman nursing students. The results indicated a decided preference for classes having direct teacher involvement and guidance such as lectures, guest speakers, movies and SAS sessions. The

majority felt that the audio-tutorial sessions were helpful and should be part of the course requirements. Half of the group preferred small groups for viewing the filmstrips and slides while the other half stated a preference for individual viewing and study.

3. The third objective of utilizing the audio-tutorial laboratory for individual study was somewhat limited because not all the equipment for individual students use has not arrived. However, we were able to evaluate the Graflex Rear-View Slide Projector for individual use. Our conclusions are that the machine is far from student-proof. Each time the machine was used the slides would jam, making it impossible to complete the exercise. Also, the slides slip readily out of the carousel when being handled.

The Dukane Filmstrip A-V-Matic projectors have not yet arrived so that we were unable to evaluate them in relation to individual student learning. We have one which was used for small groups of students. The A-V-Matic appears to be easy for the student to work and handle. Also, it can be placed in the individual carrels in the audio-tutorial lab.

Another aspect of the project was to review commercially prepared media for possible purchase. A number of filmloops, filmstrips, movies, etc., were provided. Our recommendations will be submitted to the Division.

Conclusion - Just a personal comment - anyone wishing to do anything "innovative" must be prepared to meet up with numerous little frustrations along the way. The problems with how to do this and that, and all the red-tape could discourage one. However, even though the results of what has been done are inconclusive on the project, I found that the people who are our

backbone - the IMC and multi-media staff, my student typist, the artist doing the drawings, the staff (in particularly the vocational office) bailed me out many times. The student reaction, too, has been just great, so it's been frustrating but fulfilling. It's a real learning experience for this teacher.

CONCLUSIONS

In general, efforts at evaluating instructional effectiveness are either normative in nature or solicit student opinions as to the quality of the performance. In order for instructional evaluation to be performed most meaningfully, it must be conducted in terms of specific educational objectives that are being taught by the educational systems under question. In addition, some rigorous efforts must be devoted to selecting control and experimental groups and in pre- and post-testing the students undergoing the training program. Without these constraints, no effective evaluation can take place. Unfortunately, this type of thing is very difficult to perform. By and large, teachers are unwilling to have their students treated as guinea pigs and react rather negatively to the whole notion of evaluation efforts conducted in a rigorous, quantifiable manner. "After all," many argue, "the things I teach, and the people I try to teach it to, cannot be measured in quantified terms. How can you evaluate the quality of my efforts by assigning numbers to these things?"

More specifically, the difficulties in evaluating instructional effectiveness are four in number. First, and this has been mentioned already, teacher unwillingness to use their students as guinea pigs is the most troublesome problem. Second, conducting comparisons that are, in fact, fair and selecting experimental and control groups that are, in fact, comparable is a

most difficult job. Three, establishing criteria of success or criteria of evaluation is also most difficult. Four, the validity of measuring instruments for educational programs is also sometimes difficult to establish. By and large, all four of these difficulties combine into a total situation that makes the researcher's job most difficult.

It would have been best if this paper could have compared relative costs of a particular learning system and the relative effectiveness of that system as well with conventional instruction. This could not be done. Those few examples in which rigorous analysis of comparative effectiveness are available are such that rigorous cost analysis cannot be performed. The summative examples of effectiveness comparison presented here both involved the use of computer assisted instruction. To this writer's knowledge this is the only serious effort at evaluating two instructional systems based upon specifically stated educational objectives available in the District. As both of these systems make use of computer assisted instruction it remains then to evaluate these systems in terms of the relative costs of computer assisted instruction as compared to conventional instruction. As the computer system is utilized in the Coast Community College District, however, there is no adequate way to calculate the cost involved in conducting computer assisted instruction. Even if there were, no records are maintained as to the amount of time any one student spends at a computer terminal undergoing computer assisted instruction. Thus, even if we could determine a dollar figure per hour of computer assisted instruction, we have no way of knowing how many hours any one student spent making use of it. Once again, it's a cost accounting problem, complicated by the problem of keeping track of who is making use of what terminals. The District has been loath to formalize the manner in which students make use of

computer terminals, feeling that sign-in sheets and other check-in, check-out procedures would tend to dissuade students from participating in this activity. The lack of control that results is probably worth it.

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